STEEL STRUCTURES 410

410.1 DESCRIPTION

This work consists of furnishing, fabricating and erecting the steel and miscellaneous metals required for structures.

410.2 MATERIALS

Materials shall conform to the following sections:

Steel: Section 970 and 971.

Bolts: Sections 970 and 972.

Paint: Section 411.

Stud Shear Connectors: Section 970.

410.3 CONSTRUCTION REQUIREMENTS

Structural steel fabricating plants shall be certified in the AISC Quality Certification Program "Major Steel Bridge" category to fabricate steel bridge girders, trusses, and main supporting members. Structural steel fabricating plants shall be certified in the AISC Quality Certification Program "Simple Steel Bridge Structures" to fabricate highway sign structures, parts for bridges such as bridge traffic rail, cross frame diaphragms, and unspliced rolled beam girders. Facilities certified in the bridge categories must have AISC Quality Certification Program endorsement "F" if fracture critical members are indicated on the plans. Structural steel shall be fabricated, erected, welded, and painted in accordance with these specifications.

A. Shop Plans: Shop plans will be required for all structural steel and miscellaneous metal parts for structures. Shop plans for steel structures and structural steel components shall give full detailed dimensions and sizes of component parts of the structures and details of all miscellaneous parts such as pins, nuts, bolts, drains, etc. Where specific orientation of plates is required, the direction of rolling of plates shall be shown. Shop plans shall identify the material type and grade for each piece of structural steel.

Each drawing shall be completely titled according to the contract plans, including structure number, project number, and county. Each drawing shall pertain to only one structure. The Contractor shall be responsible for the shop drawings satisfying contract requirements, regardless of any approval by the Engineer.

Unless otherwise specified on the plans, the fabricator shall initially submit three copies of the shop plans to the Office of Bridge Design for review. Shop plans shall be submitted a minimum of 15 days prior to start of fabrication. One reviewed copy will be sent back to the fabricator who will then make the necessary changes and then send six final copies to the Office of Bridge Design for approval and distribution.

B. Inspection:

1. **Notice of Beginning of Work:** The Contractor shall require the fabricator to give the Engineer 30 days notice prior to beginning work at the mill or in the shop, so inspection may be provided. The term "mill" means any rolling mill or foundry where material for the work is to be manufactured. Material shall not be manufactured or work done in the shop prior to notification.

2. **Facilities for Inspection:** Facilities for the inspection of material and workmanship in the mill and shop shall be furnished. The inspector shall be allowed free access to the work.

3. **Rejections:** The acceptance of any material or finished members by the inspector shall not preclude the subsequent rejection if found defective by the Engineer. Rejected material and workmanship shall be replaced or repaired.

4. **Identification of Steel:** The Contractor shall require the fabricator to demonstrate, by a written procedure and by actual practice, a method of material application and traceability, visible at least through the "fit up" operation, of the main stress carrying elements of a shipping piece. The traceability method shall be capable of verifying proper material application as it relates to:

   -Material Specification designation.
   -Heat Number if required.
   -Material test reports for special requirements where required.

C. Welding and Welding Inspection: Shop and field welding and welding inspection of structural steel and steel railing shall be done in accordance with the latest edition of the ANSI/AASHTO/AWS D1.5- Bridge Welding Code, (hereinafter referred to as the Code) except that steel tubular sections shall be done in accordance with the latest edition of the ANSI/AWS D1.1 Structural Welding Code - Steel.

Magnetic particle testing shall be in accordance with the Code except that only the yoke (AC) method shall be used.

In addition to the Code requirements, magnetic particle testing is required for fillet welds attaching diaphragm stiffeners to girder flanges. When this detail is present on the plans, magnetic particle testing shall be in accordance with the following requirements: 100 percent of all such joints shall be tested full length. The term “joint”, as used above, shall be interpreted as meaning the short fillet welds on each side of the stiffener connecting one end of the stiffener to either the top or bottom flange.

Approved Welding Procedure Specifications (WPS) are required for all welding. WPS’s shall be based upon Procedure Qualification Testing (PQT) in accordance with the Code. The cost of the WPS and PQT shall be incidental to the contract lump sum price for structural steel.

Electroslag or Electrogas welding processes shall not be used.

Shear connectors shall be shop welded and inspected in accordance with the requirements of Section 7 of the Code. Shear connectors shall be end welded with automatically timed stud welding equipment.

D. Welder Qualification: Welders, Welding Operators, and Tack Welders (hereafter the term Welder shall refer to all three) shall be qualified in accordance with the latest edition of the Code. Welders, except Tack Welders, shall be qualified for an unlimited thickness groove weld in test Position 3G (vertical). If the project requires overhead welding, qualification in Position 4G (overhead) will also be required. Tack Welders shall be qualified in accordance with the Code. Welder qualification shall be performed under the supervision of an AWS Certified Welding Inspector (CWI) qualified and certified in accordance with the provisions of AWS QC1. In addition to these requirements, shop welders shall be certified for the process and position that is to be used in fabrication. The fabricator shall keep records of the process and position that all welders are qualified for.

Inspectors performing nondestructive inspection, other than visual inspection shall be qualified in accordance with the American Society for Nondestructive Testing (ASNT) "Recommended Practice No. SNTC-TC-1A, Level II." Test results shall be recorded on the "Welder and Welding Operator Qualification Record," Form E-4 (Appendix III of the Code), signed by the inspector and submitted to the Bridge Construction Engineer (BCE). If approved, the BCE will issue a Welder Certification Card to the Welder.

Welding will not be allowed without a valid Welder Certification Card. The BCE will accept Form E-4's for review on which the test date is not more than one year old. If the test date is more than one year but not more than two years old, the BCE will also require evidence of continued employment as a Welder or Welding Operator. If the test date is more than two years old, retesting will be required. Welder certification cards will remain valid indefinitely unless the Welder is not engaged in the processes of welding, for which he is qualified, for a period exceeding six months. If there is some reason to question the Welder's ability the Engineer may revoke the Welder Certification Card unless a satisfactory retest is accomplished.

E. Shop Assembling:

1. Cleaning Surfaces: Surfaces of metal in contact shall be cleaned before assembling.

When weathering steel is specified or used, all structural steel surfaces of the superstructure shall be blast cleaned to a commercial finish in accordance with SSPC SP6 at the fabricator. Abrasives used for blast cleaning shall be clean dry sand, steel shot, mineral grit, or manufactured grit. Fins, tears, slivers, and burred or sharp edges shall be removed by grinding and then reblasted to achieve the specified finish.

2. Bolted Connections: All fastener holes shall be either punched or drilled. In all cases hereafter, drilling may be substituted for punching of full size holes, subdrilling may be substituted for subpunching, and holes may be drilled in assembly "from the solid" instead of being subpunched or subdrilled and reamed.

Drilling in assembly shall be done with the material in the same configuration required for reaming. Holes punched or drilled full size shall be 1/16 inch (2 mm) larger than the nominal diameter of the fasteners. Subpunched holes for fastener diameters greater than 5/8 inch (15 mm) shall be 3/16 inch (5 mm) smaller than the nominal diameter of the fasteners. For smaller fasteners, the holes shall be subpunched to the fasteners nominal diameter. Subpunched or subdrilled holes shall be reamed to 1/16 inches (2 mm) larger than the nominal diameter of the fastener.

Holes in carbon steel thicker than ¾ inch (20 mm) or alloy steel thicker than 5/8 inch (16 mm) shall be drilled or subdrilled and reamed. Punching or subpunching shall not be permitted.

Where reaming is not required, holes in carbon steel up to ¾ inch (20 mm) thick or in alloy steel up to 5/8 inch (16 mm) thick may be punched to their final specified size.

Holes for main truss or arch connections, field connections of skewed portals, splices or rigidly framed end connections of main beams or girders and rigid frames carrying design loads shall be subpunched and reamed with members assembled in the shop. For beams and girders, this assembly may be made in the web-horizontal position, except horizontally curved members shall be assembled with the web-vertical, unless web-horizontal assembly is approved by the Engineer.

The assembly, including the camber, alignment, and accuracy, of subpunched holes and mill-to-bear joints shall be approved by the Engineer before reaming is commenced.

Holes may be punched or drilled to their final specified size for field connections of secondary items including: lateral bracing for girders, truss chords and arch ribs; hanger supports for laterals and utilities; portal and sway bracing; and cross frames or diaphragms that do not require reamed holes. All holes for end field connections of floor beams shall be subpunched or subdrilled to a hardened steel template, and corresponding holes in the members to which they connect shall be reamed with the members assembled. Stringer connections to floor beams may have holes punched or drilled to their final specified size. Reaming templates shall have hardened steel bushings and reference lines inscribed to locate the template on the members.

Computer-numerically-controlled (CNC) equipment may be used to produce full sized holes in components otherwise requiring reamed, subsized holes, subject to the Engineer's approval and the demonstrated accuracy of the CNC system. Accuracy must be verified by periodic check assemblies of components, and the Contractor's quality control plan for the system must be acceptable to the Engineer. Errors detected by check assemblies will require additional assemblies to define the extent of problems and subsequent CNC work may be restricted or prohibited until system corrections are accepted by the Engineer.

a. Punched Holes: The diameter of the die shall not exceed the diameter of the punch by more than 1/16 inch (2 mm). Holes shall be cleanly cut, without torn or ragged edges.

b. Accuracy of Unreamed Holes: All subdrilled or subpunched holes shall be so accurate that after steel is assembled and before reaming, a cylindrical pin 1/8 inch (3 mm) smaller

in diameter than the punched hole may be inserted perpendicular to the face of the member, without drifting, through at least 75 percent of the holes in the connection or the pieces will be rejected. Holes punched or drilled to their final specified size without assembly shall be so accurate that fasteners may be installed without reaming or additional drilling.

c. Reamed or Drilled Holes: Reaming and drilling shall be perpendicular to the faying (contact) surface of the connection. Drilling shall be done with twist drills and reaming with fluted or adjustable reamers. Where practical, reaming shall be directed by mechanical means, and done after all the components are assembled and firmly secured. Unless otherwise approved by the Engineer, assembled parts shall be taken apart for removal of cutting oil, shavings, and burrs caused by drilling and reaming.

d. Accuracy of Reamed and Drilled Holes: Where full size holes are reamed, drilled from the solid, or made by CNC equipment, 85 percent of the holes in any group shall show no offset greater than 1/32 inch (1 mm) between adjacent thicknesses of metal.

The Contractor shall be responsible for the accuracy of all holes, regardless of tolerance in dimensions of rolled sections or fabricated members. If the required accuracy cannot be obtained otherwise, holes shall be drilled with the members assembled.

e. Assembly: Only the girder or beam sections involved in the reaming of a particular connection must be assembled at any one time. The sections involved, including all splice plates and filler plates, shall be assembled and firmly drawn together with bolts before reaming. A 1/8 inch (3mm) or greater difference in plate thickness or member depths across a bolted splice shall be rectified with shims included during reaming, match marked, and shipped with the member. The cost for additional shim plates required due to no fault of the Department shall be borne by the Contractor.

f. Disassembly: After disassembly, all burrs and shavings produced by the reaming operation shall be removed.

F. Painting Structures: Painting structures shall be in accordance with Section 411. New structural steel shall have all paint, including the finish coats of paint applied in the shop prior to shipment unless otherwise specified in the plans.

G. Transportation, Handling, Storage and Erection: Structural steel shall be loaded, transported, unloaded, and stored without damaging the material. Material shall be stored on skids above the ground, so the materials can be kept clean and drained. Girders and beams shall be placed upright and shored. Long members, such as columns and chords, shall be supported on skids properly spaced to prevent deflection. High strength bolts shall be stored so they will be kept free from rust or foreign material.

Girders shall not be placed until the supporting concrete, including grout used to construct bearing pads, has met the time and strength requirements of Section 460.3.P. Forming operations for the deck shall not begin until all of the girders in a continuous unit have been erected and adjusted and required erection elevations taken.

1. **Falsework:** The falsework shall conform to the requirements of Section 423.

2. **Bearings and Anchorages:** Bridge bearings shall be set level, in exact position, and must have full and even bearing on the concrete.

   Elastomeric bearing pads shall set directly on the concrete.

   Cast iron, steel or rolled steel bearings shall be bedded on the concrete with a single thickness sheet of preformed fabric bearing pad.

   Anchor bolts may be set in the concrete or the concrete blocked out and the bolts set later. When holes are blocked out, they shall be approximately four inches in diameter to allow for horizontal adjustment of the bolts.

   Location of anchors and setting of rockers or rollers shall take into account any variation from the mean temperature at time of setting and anticipated lengthening of bottom chord or bottom flange due to dead load after setting. At mean temperature or the temperature indicated on the contract and under dead load, the rockers and rollers shall set vertical and the anchor bolts at expansion bearings shall be centered in their slots. Full and free movement of the superstructure at the movable bearings must not be restricted by improper setting or adjustment of bearings or anchor bolts and nuts.

   Bridge bearings shall not be placed on masonry bearing areas, which are irregular or improperly formed.

   Grout used to set anchor bolts and construct bearing pads shall conform to the requirements of Section 460.3.S

3. **Straightening Bent Material and Cambering:** The straightening of plates, angles, other shapes and built-up members shall be done by methods that will not produce fracture or other injury. Distorted members shall be straightened by mechanical means or by the carefully planned and supervised application of a limited amount of localized heat. Heat straightening of ASTM A514/A517 steel members shall be done only under rigidly controlled procedures. The maximum temperature of the ASTM A514/A517 steel shall not exceed 1125° F (605° C), nor shall the temperature exceed 950° F (510° C) within six inches of weld metal. Heat shall not be applied directly on weld metal. In all other steels, the temperature of the heated area shall not exceed 1150°F (620° C). Temperature shall be controlled by indicating-crayons, liquids or bimetal thermometers.

   Parts to be heat straightened shall be free of stress and external forces, except stress resulting from mechanical means used with the application of heat.

   Following the straightening of a bend or buckle, the surface of the metal shall be inspected for evidence of fracture.

Correction of errors in camber in welded beams and girders of ASTM A514/A517 material shall be done only under rigidly controlled procedures.

4. Field Assembly: The parts shall be accurately assembled and match-marks shall be followed. The material shall be handled so parts will not be bent, broken or damaged. Hammering which injures or distorts the members shall not be done. Bearing surfaces and surfaces to be in permanent contact shall be cleaned before the members are assembled. Unless erected by the cantilever method, truss spans shall be erected on blocking to give the trusses proper camber. The blocking shall be left in place until the tension chord splices are fully bolted and all other truss connections pinned and bolted. Permanent bolts in splices of butt joints of compressions members and permanent bolts in railings shall not be tightened until the span has been swung.

Splices and field connections shall be faired up with a sufficient number of fit-up-bolts or erection pins to maintain dimensions and plumbness of the structure and allow free entry of the bolts used in the final connection. Girder erection data given on the contract shall be utilized to establish proper girder profile, prior to final tightening to the bolts in the splices. Drifting during assembly to bring the parts into position shall not enlarge holes or distort the metal.

5. High-Strength Bolts: Shall conform to Section 972 and the following:

a. High-strength bolts shall be new ASTM A325 Type I bolts, unless otherwise specified on the plans.

b. Unless otherwise specified, high-strength bolts require tightening using direct tension indicators.

1) Direct tension indicators shall be mechanically galvanized in accordance with Class 50 of ASTM B695.

2) The average load indicator gap shall be reduced to 0.005 inches (0.125 mm) while tightening. The appropriate 0.005 inch (0.125 mm) feeler gauge shall be supplied.

3) When direct tension indicators shall be used adjacent to weathering steel, they shall be mechanically galvanized in accordance with Class 50 of ASTM B695 and epoxy coated after galvanizing in accordance with AASHTO M284.

c. Fasteners shall be protected from accumulating dirt prior to installation. Weathered, rusted, or soiled fasteners shall be cleaned and relubricated prior to installation.

d. High strength fasteners shall be subjected to a rotational-capacity test in accordance with SD507.

e. A Skidmore-Wilhelm Calibrator, or other acceptable bolt tension indicating device, will be furnished by the Department at each job site during bolt installation. The Contractor shall provide the Department a minimum notice of 1 week prior to installing bolts.

6. Connections Using High Strength Bolts: Girder splices and other structural joints utilizing high strength bolts in friction-type connections shall use the direct tension indicator fastening system.

a. Direct tension indicators (DTI) shall conform to the requirements of ASTM F959.

The direct tension indicators shall be capable of providing the required bolt tension when the measured gap between the direct tension indicator and the surface against which the protrusions bear is reduced to that specified. The direct tension indicator shall be specifically marked to identify the type of bolt for which it is to be used. A different marking shall be used for ASTM A325 bolts than for ASTM A490 bolts. Direct tension indicators shall be new and unused.

b. Bolt lengths shall be determined as shown in Table 1.

TABLE 1 Bolt Length (English)	
Bolt Size In Inches	Add to Grip* to Determine Bolt Length in Inches
5/8	7/8
3/4	1
7/8	1 1/8
1	1 1/4

* Grip is thickness of material to be connected, exclusive of washers. For each flat washer, add 3/16 inch to the grip. For each bevel washer, add 5/16 inch to the grip. For each direct tension indicator, add 1/8 inch to the grip.

NOTE: Irregular lengths shall be adjusted to the next longer 1/4 inch increment.

TABLE 1 Bolt Length (Metric)	
Bolt Size	Add to Grip* to Determine Bolt Length in mm
M16	20
M20	24
M22	26
M24	28

* Grip is thickness of material to be connected, exclusive of washers. For each flat washer, add 3.1 mm for M16 and M20, add 3.4 mm for M24 mm and larger to the grip. For each bevel washer, add 7.5 mm to the grip. For each direct tension indicator, add 3 mm to the grip.
NOTE: Irregular lengths shall be adjusted to the next longer 5 mm increment.

c. Bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or other interposed compressible material.

When assembled, all joint surfaces, including those adjacent to the bolt heads, nuts or washers shall be free of scale, burrs, dirt, other foreign material and defects that would prevent solid seating of parts. Tight mill scale does not apply.

In girder splices, bolted splices and other friction-type connections, all contact surfaces shall be free of oil, paint, lacquer, and other coatings, except as specified in Section 411.3.B.3.

When weathering steel is specified or used, all faying surfaces of connections shall be blast cleaned to a near-white finish in accordance with SSPC SP10 immediately prior to assembling connections in the field.

d. All fasteners shall have a hardened washer under the element turned in tightening. For installations utilizing ASTM A490 bolts where the steel work comprising the grip has a specified yield strength less than 40 ksi (275 MPa), special requirements for hardened washers will be noted on the contract.

When the outer face of the bolted parts has a slope of more than 1:20 with respect to a plane normal to the bolt axis, a smooth hardened beveled washer shall be used to compensate for the lack of parallelism.

In the normal installation, the direct tension indicator shall be placed on the bolt with the protrusions bearing against the underside of the bolt head. For this type installation, the nut is the turned element and the hardened washer will be placed between the steelwork and the nut.

If required, due to bolt entering and wrench operation clearances, it will be permissible to use the bolt head as the turned element. In this type installation, a hardened washer shall be placed under the bolt head and the direct tension indicator placed on the bolt with its protrusions bearing against the hardened washer.

In those installations, where inspection of the bolt head is too difficult, it will be permissible to place the direct tension indicator at the nut end. The direct tension indicator shall be placed on the bolt with protrusions facing toward the nut. A hardened washer is then placed on the bolt against the protrusions and the nut is installed. With this type installation, the nut is the turned element. Direct tension indicator protrusions shall bear against a hardened surface.

The surface contacting the protrusions of a direct tension indicator shall not turn during the tightening operation. For those type installations where the direct tension indicator is used adjacent to a hardened round washer, some slight movement of the hardened round washer is acceptable.

On bolt installations where beveled washers are used, or galvanized bolts are specified, or slotted or oversize holes are used, special requirements for hardened round washers and direct tension indicators must be observed, as provided in the contract.

e. All bolts in a joint shall be tightened to reduce the gap between the washer face of the bolt head and the face of the direct tension indicator. If the direct tension indicator is installed nearest to the turned element, between the face of the direct tension indicator and the hardened round washer, the average gap shall conform to that specified in Section 410.3.G.5.b.

When the average gap is equal to or less than that specified in Section 410.3.G.5.b, the minimum required fastener tension shall be assumed satisfied, unless the Engineer determines additional verification is required.

A sufficient number of bolts shall first be placed in the joint and "snugged" to insure that all faying surfaces are in firm contact, prior to tightening. Snug tight is defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary wrench. Bolts shall be placed in any remaining holes and snugged tight as erection bolts or pins are removed. All bolts in the joint shall then be tightened progressing systematically from the center most rigid part of the joint to its free edges. When tightening, the element not turned shall be held with a hand wrench to prevent rotation.

The gap between the bolt head and the face of the direct tension indicator is reduced while tensioning, due to the bolt clamping force, which flattens the washer protrusions. When tightening, complete closure of the gap around the circumference should be avoided, to prevent over tightening the bolt. The gap may not be uniform around the circumference of the direct tension indicator as the wrench may pull the bolt off center in the hole, resulting in non-uniform compression of the protrusions. When non-uniform gap exists, the average gap criteria is satisfied if the gap measured at several points around the circumference shows 50 percent of the measurements to be equal to or less than the value specified in Section 410.3.G.5.b. If there is no gap at only one point on the circumference, the bolt is properly tightened and no further tightening shall be attempted.

Impact wrenches shall be of adequate capacity to perform the required tightening of each bolt in approximately 10 seconds.

The Contractor shall check the gap on a sufficient number of bolts to assure that the completed joint meets the requirements of this specification. A metal feeler gauge capable of probing between adjacent protrusions of the direct tension indicator shall be supplied by the Contractor. The Contractor shall supply the Engineer with an identical gauge for inspection.

After all bolts in a joint have been tightened, the Contractor shall return to the first bolts tightened to assure that they have not loosened. Lost tension may be restored by tightening so that the gap is slightly less than originally measured.

f. In order to determine acceptability of direct tension indicators prior to their actual installation, the Engineer shall:

1) Sample and test the direct tension indicators in accordance with SD 503. The cost for the bolts and direct tension indicators used for field verification shall be incidental to the cost for the structural steel.

2) Have full opportunity to witness installation of bolted connections and shall periodically observe the installation and tightening operation to ensure that proper procedures are being adhered to.

3) Determine that all bolts have been tightened upon completion of a bolted joint. A minimum of 20 percent, but not less than four bolts in each joint, shall be inspected with a metal feeler gauge. If all gaps checked are within the allowable distance described, the joint shall be accepted as properly tightened. If gaps checked are in excess of that specified, the Contractor shall reinspect and retighten each bolt in the joint, as required, and resubmit the joint for inspection.

The metal feeler gauge shall be used as a "no go" inspection tool by inserting the tapered nose of the gauge into the openings between protrusions. If the gauge does not enter, but a gap is evident, the installation is acceptable.

7. **Pin Connections:** Pilot and driving nuts shall be used in driving pins. They shall be furnished by the Contractor without charge to the Department. Pins shall be driven so the members will take full bearing on them. Pin nuts shall be screwed up tight and the threads burred at the face of the nut with a pointed tool.

8. **Misfits:** The correction of minor misfits involving harmless amounts of reaming, cutting, and chipping will be considered a legitimate part of the erection. Any error in the shop fabrication or deformation resulting from handling and transportation which prevents the proper assembling and fitting of parts by the moderate use of drift pins or by a moderate amount of reaming and slight chipping or cutting, shall be reported immediately to the Engineer. The Engineer's approval of the method of correction shall be obtained. The correction shall be made in the Engineer's presence. The Contractor shall be responsible for all misfits, errors, and injuries and shall make the necessary corrections and replacements.

410.5 METHOD OF MEASUREMENT

Field measurement of structural steel will not be required. Adjustment in the contract price will not be made if the weight furnished is more or less than the estimated weight.

The weights of rolled shapes, slabs and plates will be computed on the basis of their nominal weights and dimensions. The weight will be computed on the following basis:

Unit weights of material in pounds per cubic foot (kilograms per cubic meter):

Cast Iron..... 445.0 (7128.0)
Copper Sheet..... 558.0 (8938.0)
Lead Sheet..... 707.0 (11325.0)

Steel: cast, copper bearing, silicone,
nickel or stainless.....490.0 (7849.0)
Wrought Iron..... 487.0 (7801.0)
Zinc.....… 450.0 (7208.0)
Bronze or Copper-Alloy Bearing Plates..... 490.0 (7849.0)

The quantities of the various other pay items, which constitute the completed and accepted structure, will be measured for payment according to the plans and specifications.

410.5 BASIS OF PAYMENT

Structural steel will be paid for at the lump sum contract price. Payment will be full compensation for furnishing, fabricating, delivery, erecting ready for use, for the required non-destructive weld testing by radiographing, magnetic particle, ultrasonic inspection, or other specified alternate test procedures. Payment shall also include painting of the structural steel, unless a separate bridge painting bid item is included in the contract.

The cost of the required shear studs, bolts, nuts, washers, and direct tension indicators shall be incidental to the cost of the structural steel.

If changes in the work, which vary the weight of steel to be furnished, are ordered the payment will be adjusted as follows:

The value per pound (kilogram) of the increase or decrease in the weight of structural steel involved in the change shall be determined by dividing the contract lump sum amount by the estimate of weight shown on the plans. The overall contract payment will be the contract amount plus or minus the value of the steel involved in the change.

The accepted quantities will be paid for at contract unit price.